Department of **Water and Environmental Regulation**
Department of **Primary Industries and Regional Development**
GOVERNMENT OF WESTERN AUSTRALIA

Delivering on the Bindjareb Djilba Protection Plan | Peel-Harvey estuary

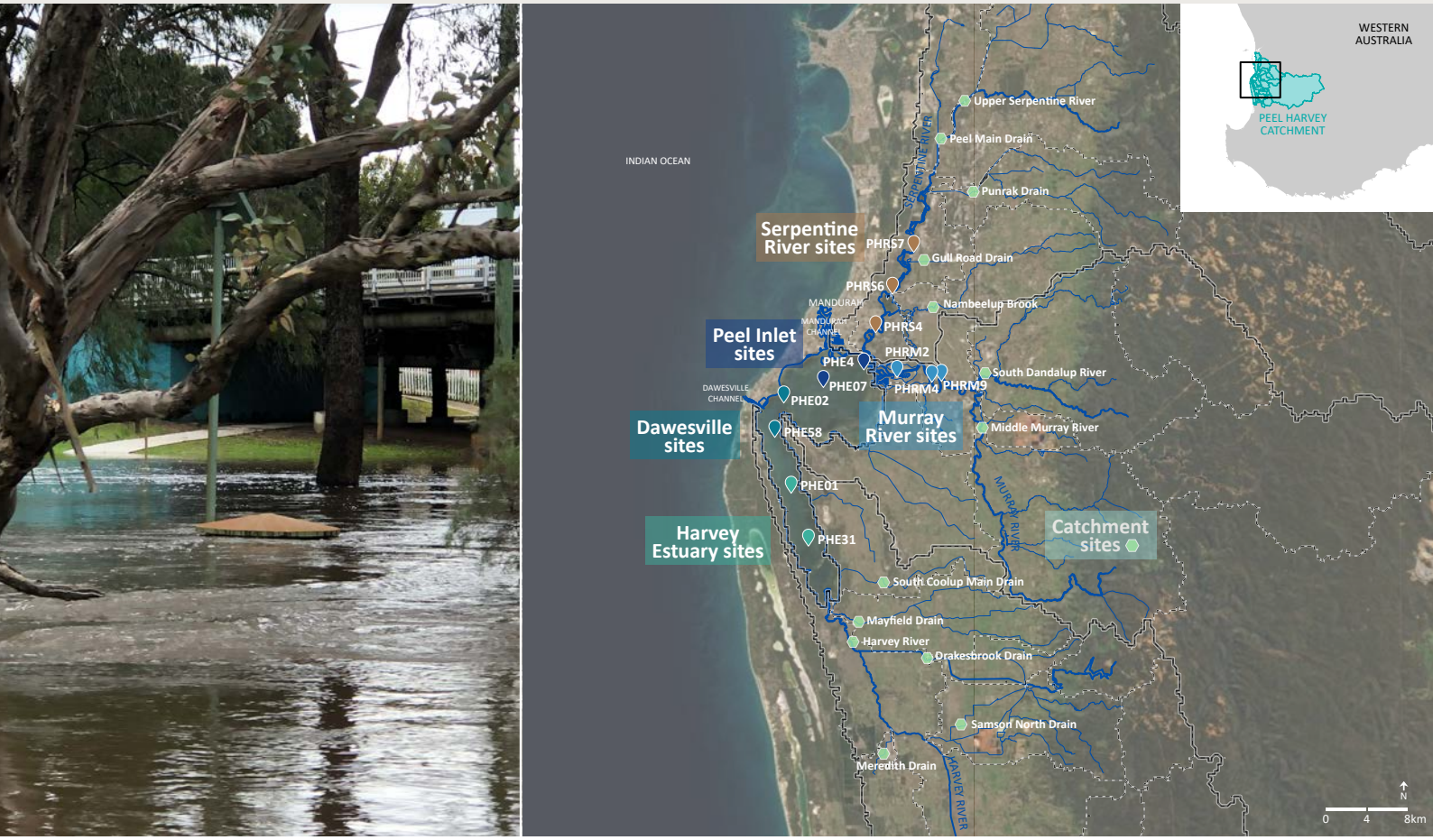
HEALTHY ESTUARIES WA

Water quality snapshot: Bindjareb Djilba (Peel-Harvey estuary) 2021–22

Through Healthy Estuaries WA, the Department of Water and Environmental Regulation monitors water quality in the Peel-Harvey estuary, the Murray and Serpentine rivers and the surrounding catchment.

This snapshot provides some insights from our water quality monitoring during 2021 and 2022.

Understanding estuary condition and monitoring for change helps to guide how we manage our estuaries



Very high flows in the Murray River at Pinjarra in July 2021. © DWER

Nutrients (nitrogen and phosphorus) in high concentrations can promote excess algal growth. Rainfall washes nutrients and organic matter from the surrounding land into the rivers so we normally find higher nutrient concentrations following winter rains.

The Peel-Harvey estuary catchment had a very wet winter in 2021, with higher than average rainfall in July that flushed nutrients from the catchment into the waterways. This increase in nutrients resulted in higher algal growth in the Murray and Serpentine rivers in winter, spring and summer, including cyanobacteria ('blue-green algae') that can be harmful to human health.

Microalgal blooms were also present in the estuary basins in winter; however, these did not persist into spring and summer. This was likely because high river flows helped flush nutrients towards the ocean and dark-tannin stained water reduced the light available for algae growth. However, the high nutrient concentrations fuelled the growth of nuisance green macroalgae ('seaweed').

A fish kill event occurred in March 2022 in the Serpentine River. This was probably linked to very low oxygen levels overnight, caused by excessive microalgal growth.

Nutrients in the estuary

We examine where nutrients are coming from and how they affect algal growth by measuring changes in nutrient types and concentrations across the estuary through the seasons.

In winter 2021, water quality in the Peel-Harvey estuary and the lower reaches of the rivers was generally poor, with most average concentrations of total nitrogen (TN) and total phosphorus (TP) above guideline values.[1] By spring and summer 2021, water quality had improved, with lower concentrations recorded in most zones. Unfortunately, this was not the case for the Serpentine River, where the average TN concentration remained high in spring and then increased during summer, and the TP concentration remained extreme.

Summer nutrient concentrations were high in the Serpentine River in part because of related algal blooms, since organic nitrogen and phosphorus in living and dead organisms are included in these measures. By summer, microalgae had consumed much of the nutrients and bioavailable nitrogen concentrations were low; however, bioavailable phosphate remained excessive. This combination then fuelled the growth of cyanophytes (potentially toxic blue-green algae that can access nitrogen from the air to help them grow).

[1] Nutrient and chlorophyll *a* concentrations are compared with ANZECC and ARMCANZ (2000) water quality guidelines for estuaries in south-west Australia. Guidelines are used to assess risk of adverse effects on water quality.

SEASONAL MEANS

surface

bottom

NUTRIENT CONCENTRATION CATEGORIES

Low	< guideline*
Moderate	= 1X to 2X guideline
High	> 2X to 3X guideline
Very High	> 3X to 4X guideline
Extreme	> 4X guideline

* ANZECC GUIDELINE VALUES

TN	0.75 mg/L	Total nitrogen
NO_x^-	0.045 mg/L	Nitrate
$NH_3+NH_4^+$	0.04 mg/L	Total ammonia
TP	0.03 mg/L	Total phosphorus
FRP	0.005 mg/L	Filterable reactive phosphorus

Salinity and oxygen

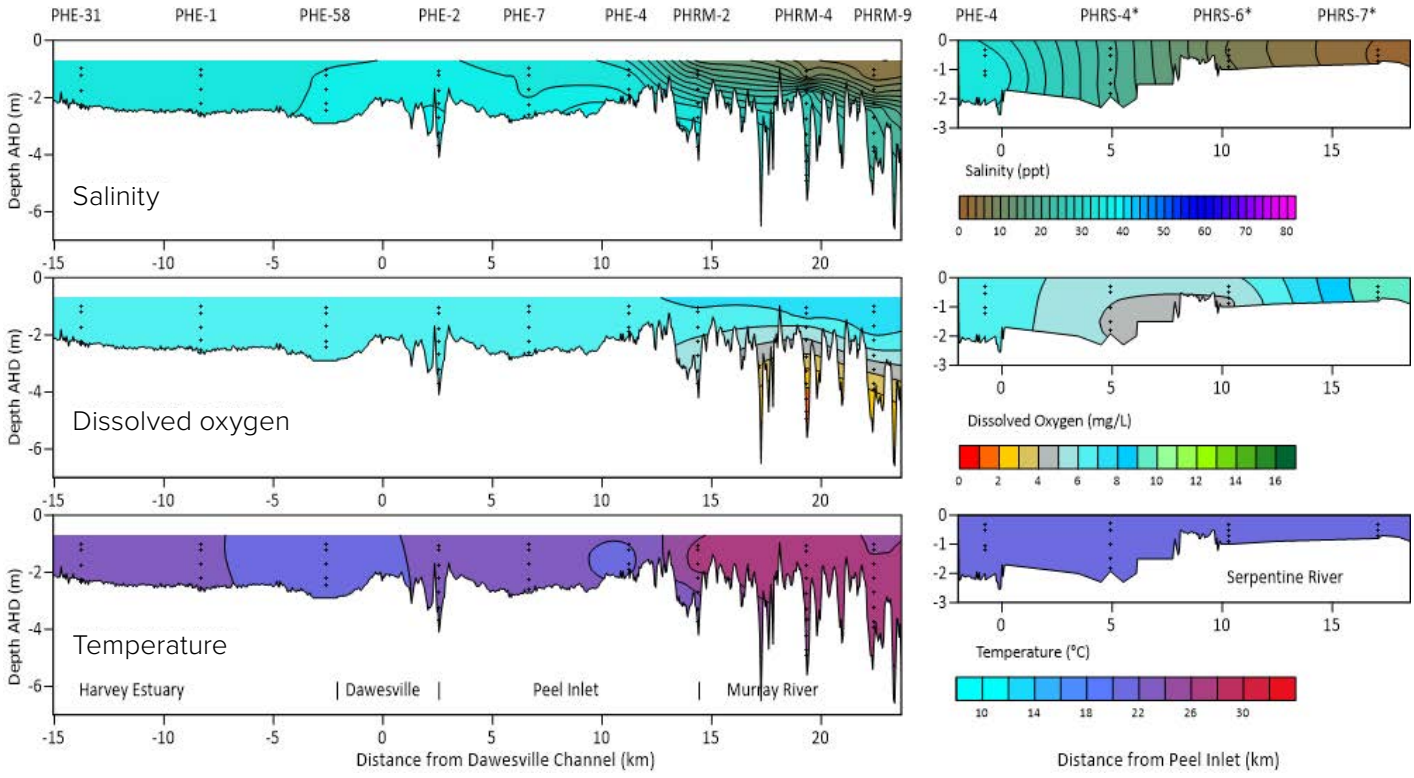
In the estuary and estuarine reaches of the rivers, when river and seawater meet but do not easily mix, we observe stratification: a process of layering where fresh water sits on top of denser salty water. This is a natural characteristic of estuaries, but it prevents the mixing of oxygen. In nutrient-rich estuaries like the Peel-Harvey, microbes consume oxygen when they decompose algae. The resulting low oxygen conditions in the deeper parts of the water column can lead to fish and other animal deaths and cause the release of even more nutrients from the sediment.

Stratification often occurs in the rivers; however, in winter 2021, fresh water flows were large enough to cause stratification throughout the estuary basins with fresh surface water extending towards the ocean.

By early summer, the waters of the estuary basin were saline again. Stratification persisted in the estuarine reaches of the Murray River, with unhealthy low oxygen concentrations in the deepest parts. In the Serpentine River, spring rainfall prolonged flows so the upper reaches were fresher than usual in summer.

Cyanophyte bloom in the Serpentine River, December 2021. © DWER

30 Nov and 1 Dec 2021



Example of a physical profile from early summer 2021 showing the low oxygen levels in parts of the Murray and Serpentine rivers. Estuary and Murray River measurements were taken on 30 November, and Serpentine River sites on 1 December.

Algal response

While algae are a natural part of aquatic ecosystems, excessive algal growth can make waterways unsightly and smelly, and can have negative impacts on fish and pose risks to human health. Microalgae can be harmful if present at high cell densities ('blooms') or if they are toxic. Microalgae grow rapidly under well-lit, warm, nutrient-rich conditions.

Despite excessive nutrients in the estuary basins in winter, there were no distinct microalgal blooms in the Peel-Harvey estuary itself in spring and summer. The strong winter flows helped flush nutrients towards the ocean, while microalgal growth was likely limited by both the cool spring temperatures and reduced light caused by the darker tannin-stained, organic-rich water from the catchment.

In the estuarine reaches of the Serpentine River, microalgal activity was elevated from spring to autumn. Prolonged nutrient-rich, fresh water conditions fuelled blooms of several microalgal groups during summer 2021–22, especially potentially toxic blue-green algae called cyanophytes. These blooms visibly coloured the water green at the upper Serpentine River sites.

Algal blooms can lead to fish kills because they reduce the amount of oxygen available in the water, which fish need to breathe. While microalgae photosynthesise and produce oxygen during the day, the oxygen depletion occurs at night because the microalgae consume oxygen for respiration. Oxygen may also be low following the decomposition of microalgae when a change of conditions causes rapid die off.

Low overnight oxygen levels caused by high microalgal activity were the probable cause of a fish kill of 5,000 to 10,000 adult and juvenile mullet that was reported in March 2022 between Lake Goegrup and Black Lake on the Serpentine River.

Members of the public reported that decomposing macroalgal mats were accumulating on the Coodanup foreshore in late spring 2021 and causing unpleasant odours. This included the green macroalgae *Chaetomorpha linum* which can grow rapidly when there are seasonal and short-term increases in nutrient concentrations. It floats as mats in the water so may be less impacted by reduced water clarity. Wind can push macroalgae around, so prevailing winds cause it to accumulate and decompose on certain foreshore areas.

Macroalgal mat accumulation on the Coodanup Foreshore, November 2021. © City of Mandurah

Outlook

The 2021–22 monitoring period shows that the Peel-Harvey estuary is susceptible to microalgae and macroalgae blooms caused by large amounts of nutrients being washed in from the catchment during high rainfall periods.

If nutrient contributions from the catchments remain excessive, the potential for algal blooms will continue to pose a threat to the healthy functioning of the estuary ecosystem, especially under the warmer and drier climate projected for the region. Compared with the high winter rainfall in 2021, years with low winter flows or short-lived inflows from unseasonal summer storms have greater potential to fuel undesirable algal blooms. This is because nutrients are not flushed out to the ocean, or they arrive when temperature, light, and reduced water movement would favour rapid algal growth.

Continuing work on land use and management in the catchment to reduce nutrient inputs remains essential to improve the health of the Peel-Harvey estuary and the system's resilience in the context of climate change.

Learn more:

Explore changes to salinity and oxygen in the estuary:
estuaries.dwer.wa.gov.au/peel-harvey-profiles

Explore other publications about Bindjareb Djilba:
estuaries.dwer.wa.gov.au/estuary/peel-harvey-estuary/publications